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E53 AWD and DSC III

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E53 AWD & DSC III

Model: E53

Production: From 9/00 to 9/03

OBJECTIVES

After completion of this module you will be able to:

- Understand transfer case design
- Understand ADB/DSC III features

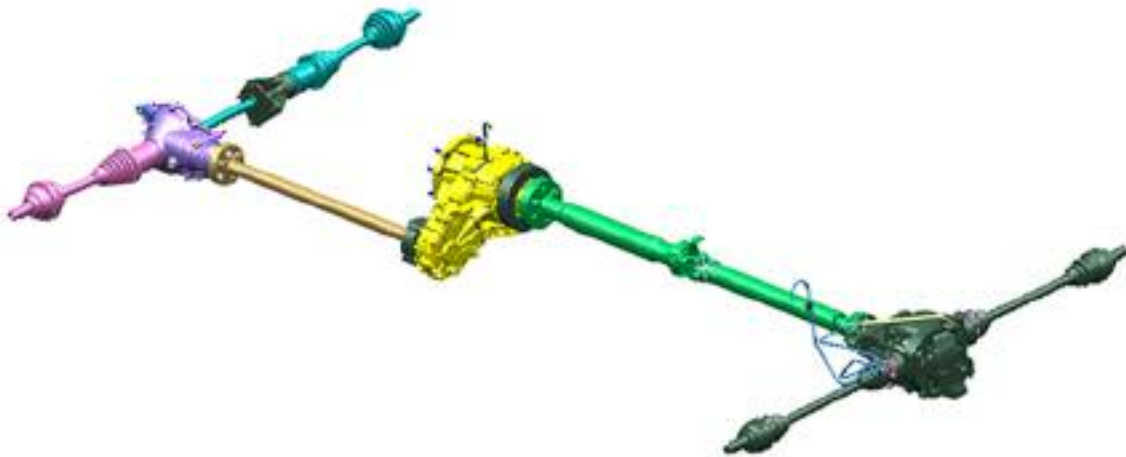
E53 AWD

Drivetrain

The transfer case, driveshafts, final drives and half shafts make up the drivetrain assembly.

The transfer case is always mounted in the same position on the X5. This applies to other markets and future models that will utilize different transmissions for different engine configurations. With these models, the transmission tail shafts will be modified to match up with the transfer case.

The rear driveshaft is a two piece unit using a center bearing, while the front drive shaft is a single piece that is splined to the transfer case and bolted to the front differential.



The breather vents for both differentials and the transfer case are mounted higher up on the chassis to prevent water from entering if the vehicle is driven off road through water. The front breather passes up into the engine compartment and is mounted under the left side ignition coil cover. The rear breather passes along the under side of the body and is mounted behind the left side wheel arch cover. The breather vent for the transfer case is mounted up high in the driveshaft tunnel.

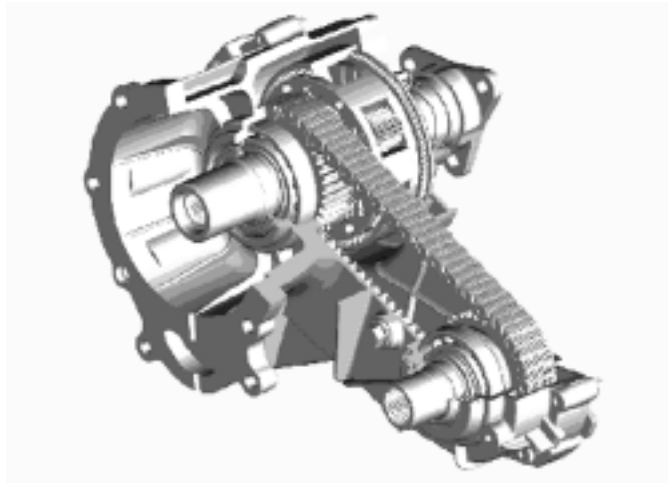


Drivetrain-Transfer Case

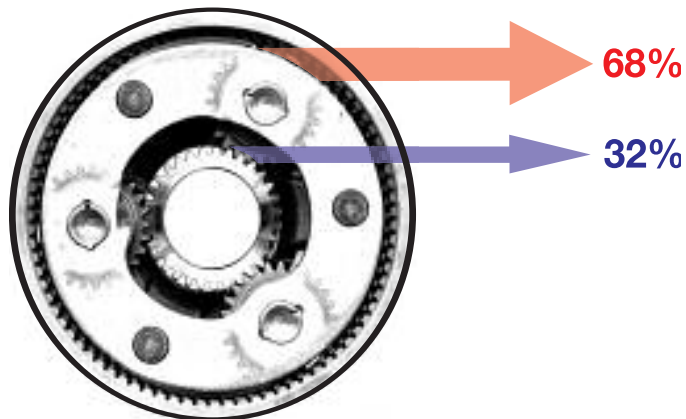
The transfer case is manufactured by New Process Gear Division of New Venture Gear Company. It is identified as model NV 125.

It incorporates a planetary gear set and chain to provide the torque split and all wheel drive. The output torque of the transmission is applied to the planetary carrier of the gear set. The rear drive shaft is connected to the annulus gear and the front drive shaft is connected to the sun gear through the chain drive.

As the output shaft of the transmission turns, the planetary carrier rotates, causing the planetary gears to drive the sun gear and annulus gear.



A torque split of 68% rear/ 32% front is provided through the gearing of the planetary set.



E53 DSC III

Features

Note: This section only describes the new DSC features that are associated with the AWD system. All other Bosch DSC 5.7 features remain unchanged.

Hill Decent Control (HDC)

Hill Decent Control (HDC) is designed for off road use to automatically slow the vehicle and maintain a steady speed on steep gradients. This function allows the driver to focus on steering and controlling the vehicle without having to use the brakes to slow the vehicle.

HDC is activated manually through the push button switch located in the center switch panel located in the console. When activated, the vehicle's speed is held to approximately 5 MPH by the DSC system pulsing the brakes to maintain the speed.

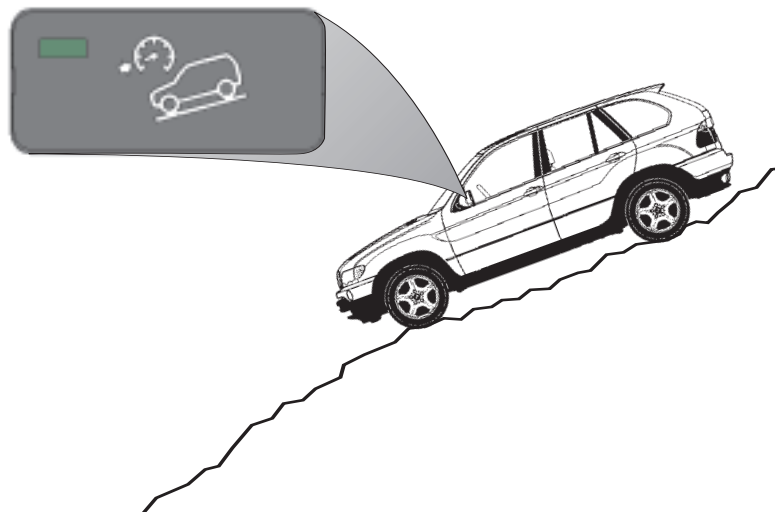
The following conditions must be met before the HDC will activate:

- Push button pressed - LED "ON"
- Vehicle speed: < 25 MPH
- Accelerator pedal pressed <15%
- Downhill driving recognized

Downhill is recognized from the vehicle's speed and engine load from the engine control module. The accelerator pedal and engine load signals are passed over the CAN bus to the DSC control module.

The HDC switch can be pressed at speeds < 37MPH and the LED will come on to indicate standby mode. However the system will not activate until the vehicle's speed is below 25.

The driver can accelerate with HDC active up to approximately 20% engine load. The HDC will stop regulating as long as the driver is requesting a speed increase. If the vehicle's speed is > 37 MPH, the HDC function is automatically switched OFF.



Automatic Differential Brake (ADB)

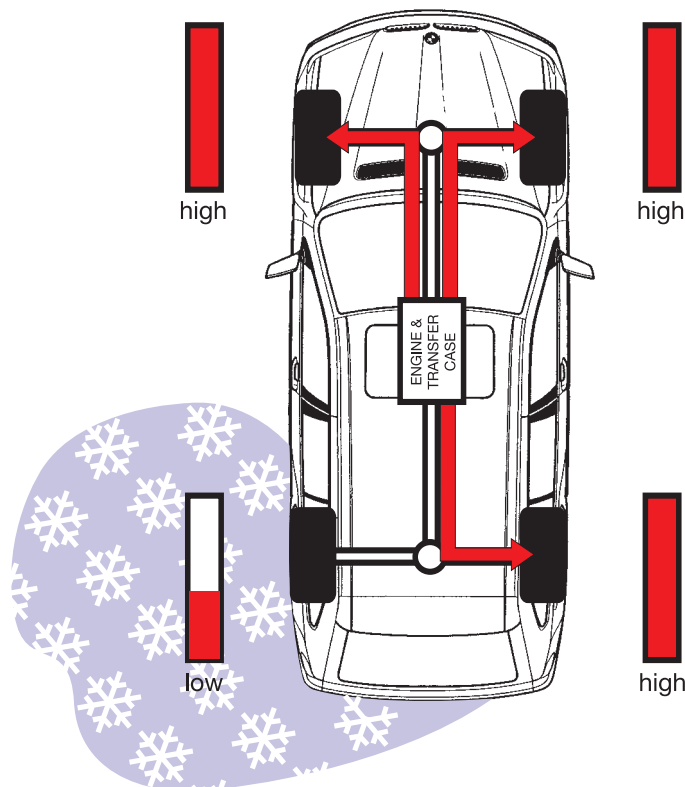
On dry pavement with no wheel slip, the vehicle's driving torque is split 68% rear and 32% front through the planetary gear differential transfer case.

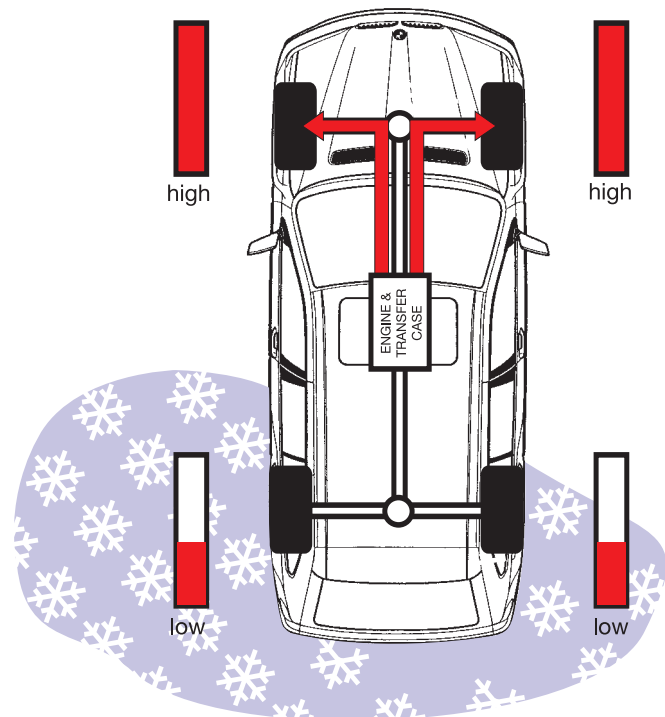
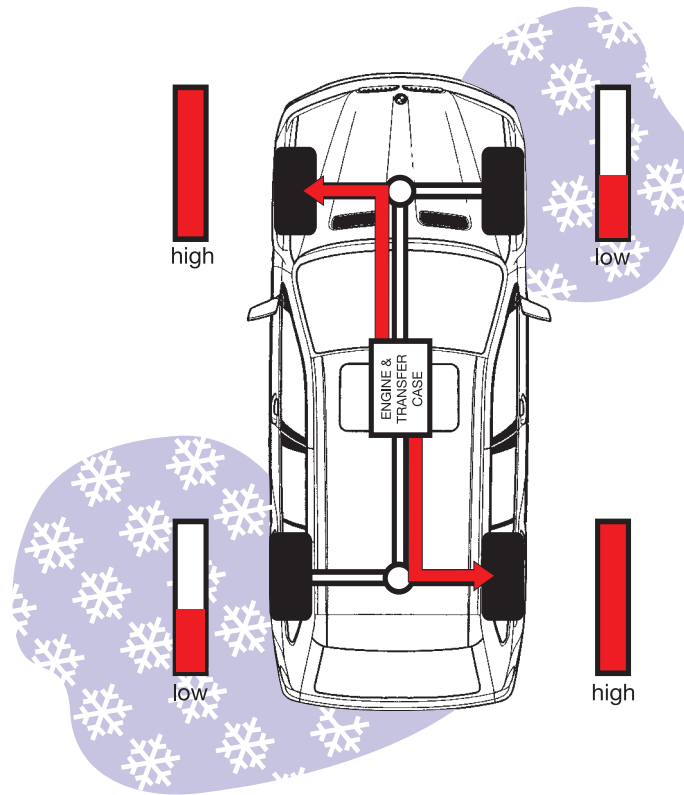
If one or more wheels spin or slip, the DSC will activate a regulation process and the brakes on the effected wheel(s) will be pulsed. The driving torque will be distributed through the differential to the remaining wheels with a good coefficient of friction

The driving torque will be applied through the differential as follows:

- Three wheels - with one wheel spinning.
- On two diagonal wheels with two wheels spinning on different axles.
- One axle only with two wheels spinning on the same axle.

Once the spin or slip is under control, the drive torque will again be applied to all wheels.





Traction Control

The traction control feature of the DSC III on the X5 cannot be switched OFF with the DSC switch. Pressing the button will only switch off the dynamic stability control function of the DSC.

The traction control feature is needed at all times to provide anti-spin control especially when driving the vehicle off road. The DSC warning lamp in the instrument cluster will still come on when the system is switched off manually or there is a fault in the system.

Off road traction control or HDC regulation places an additional load on the brakes. To prevent overheating of the brakes and rotors, the temperature of the rotors is calculated over time from the road speed and amount of brake application. If the temperature of one or more rotors goes above 600o C, the traction control or HDC function for that wheel will be cancelled temporarily. Once the temperature of the rotor goes below 500o C, the traction application will be re-activated.

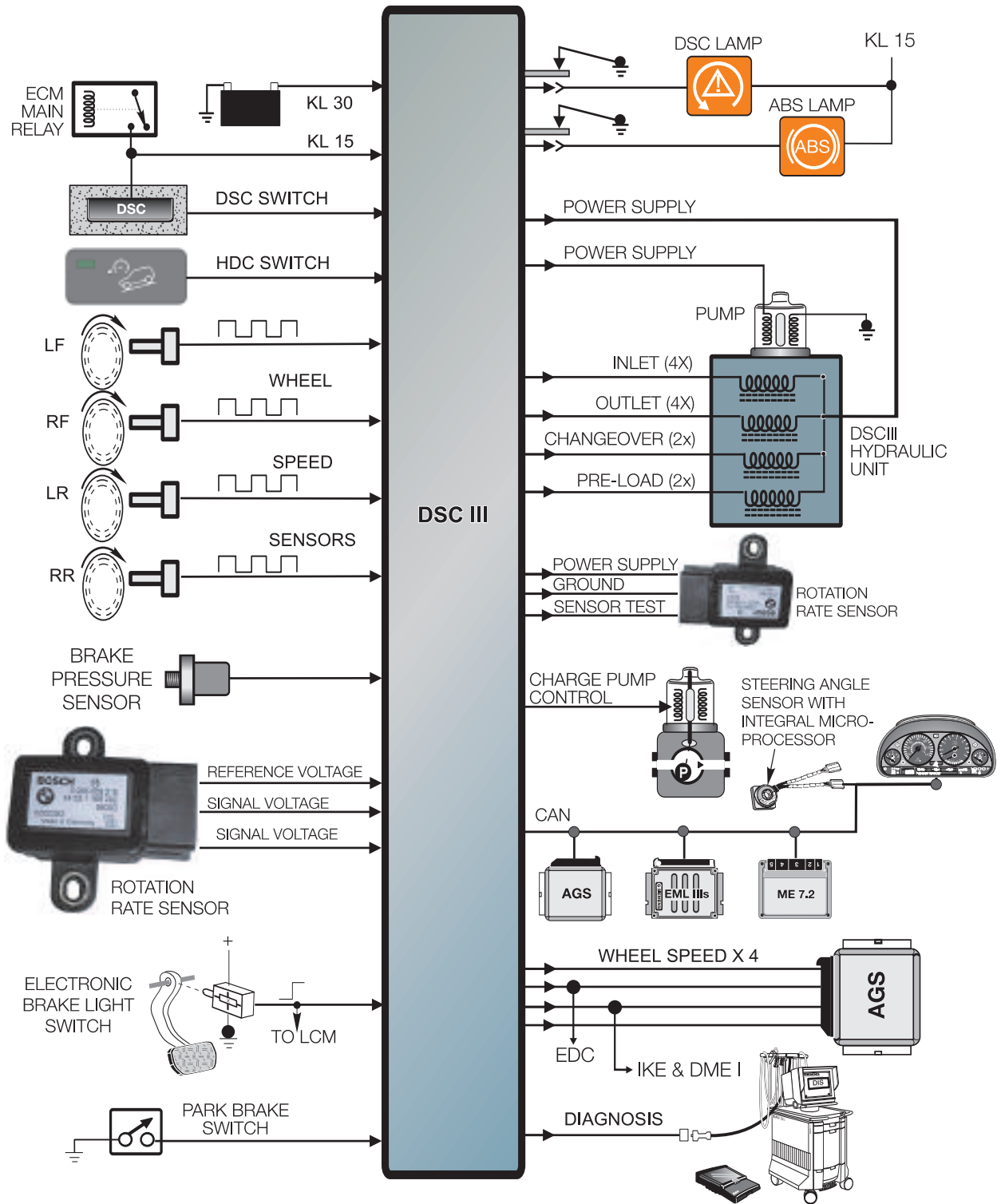
The normal braking function (including ABS) is always active at any temperatures.

Off-Road ABS Control Module Programming

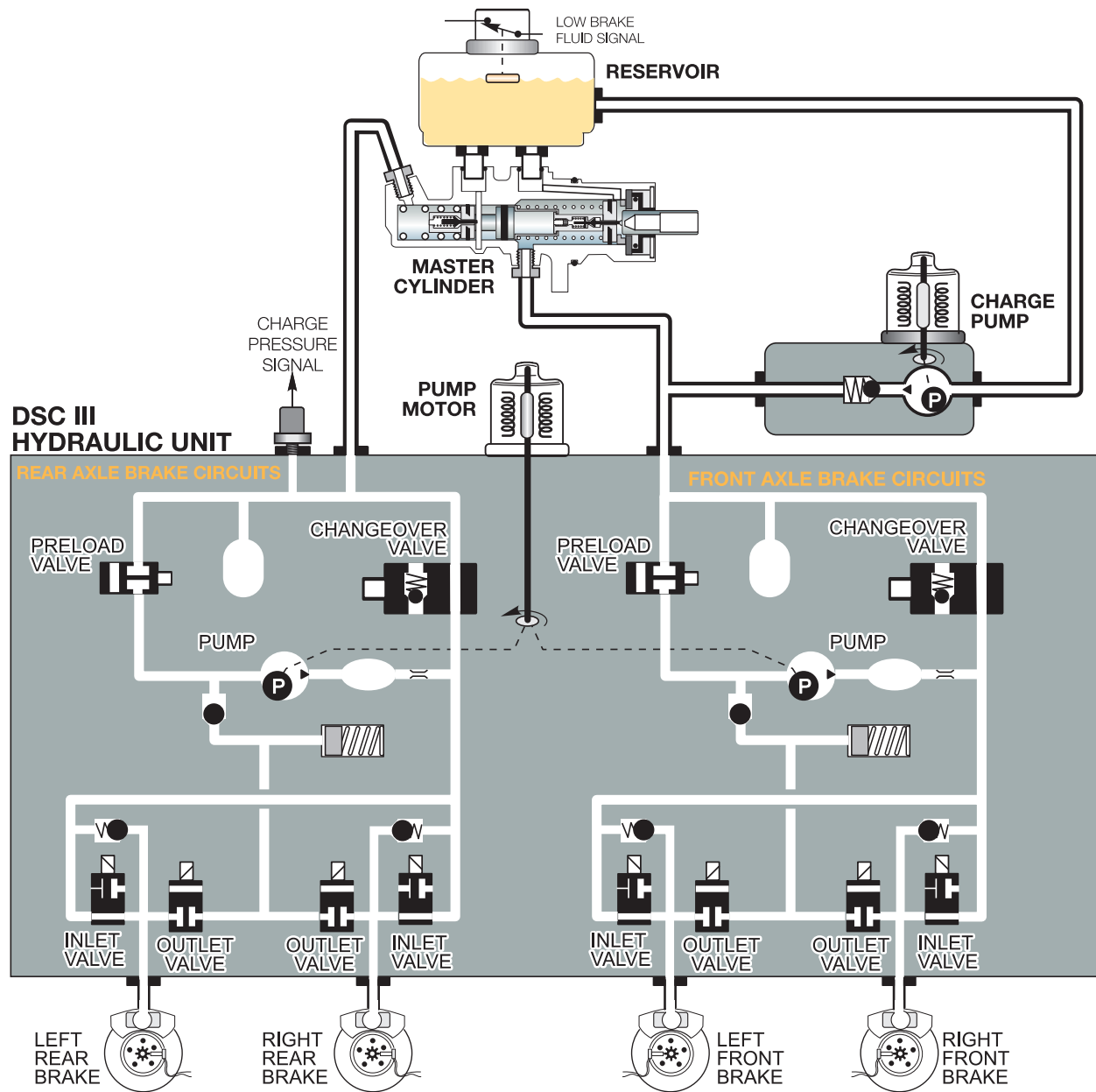
The programming for ABS regulation have changed to allow a higher threshold for ABS regulation when driving off-road in loose gravel or dirt. A locked wheel is more effective in slowing or stopping the vehicle because of the wedge that is built up in front of the tire.

The programming in the DSC control module allows one or both front wheel(s) to lock up to a speed of 12 MPH as long as the vehicle is traveling straight ahead. If the DSC control module receives a signal from the steering angle sensor indicating a turn, ABS regulation will activate to prevent the lock and allow the vehicle to be steered.

DSC III Components/IPO



DSC III Hydraulic Unit



Components

Control Module Hydraulic Unit

The control module is integrated into the hydraulic unit as one compact unit. This reduces the size and wiring required for DSC operation. Additionally the motor relay and valve relay have been replaced by solid state final stages in the control module. The hydraulic unit continues to use:

- Two pre-charge solenoid valves
- Two changeover solenoid valves
- Four intake solenoid valves
- Four outlet solenoid valves
- One return pump

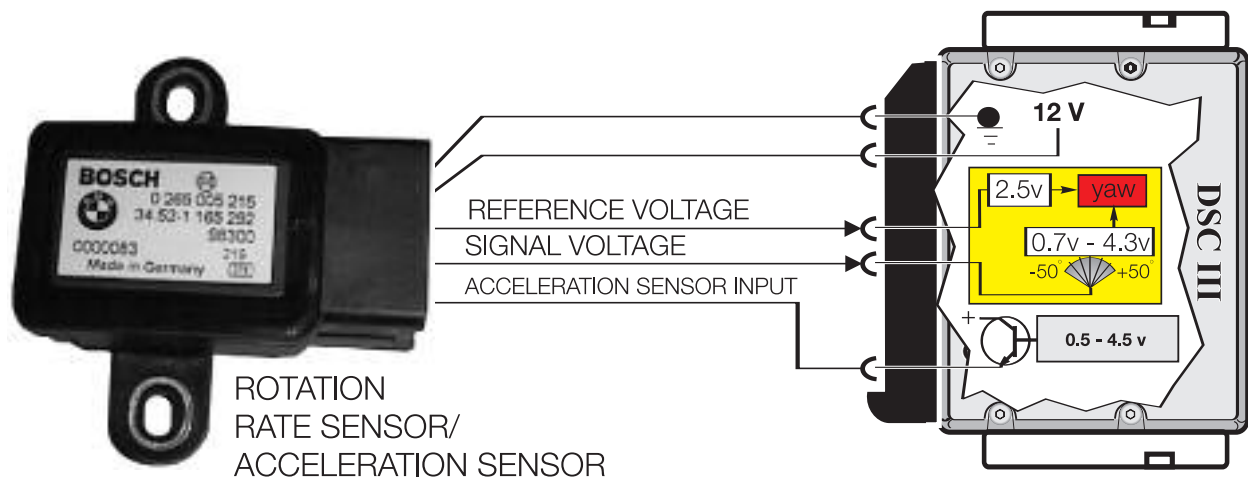


Rotation Rate/Transverse Acceleration Sensor

Located under the center console behind the MRS III control module, the rotation rate and transverse acceleration sensor provides two inputs to the DSC control module. The sensor is isolated from body/chassis vibrations through its rubber mounting.

For rotational speed, the sensor produces a reference signal of 2.5 volts and a linear voltage signal from 0.7 to 4.3 volts. This linear voltage input signal is used by the DSC control module as the degree of rotational rate (yaw).

The sensor also produces a linear voltage signal for the lateral acceleration (G-force) that ranges from 0.5 to 4.5 volts. The DSC control module uses this input to determine the side forces acting on the vehicle for DSC regulation.



Location of the Rotation Rate/Transverse Acceleration Sensor under the center console

Brake Pressure Sensor

A brake pressure sensor is installed in the hydraulic unit to determine the degree of pressure build-up for Dynamic Brake Control. It is installed in the front axle brake circuit.

The sensor receives its power supply from the DSC control module and produces a linear voltage input signal ranging from 0.5 to 4.5 volts depending on how hard the brakes are applied.



DSC III Components

HDC Switch

The hill decent control function is activated by pressing the HDC switch located in the center console. The LED will come on steady when the function is in standby and flash when HDC is regulating



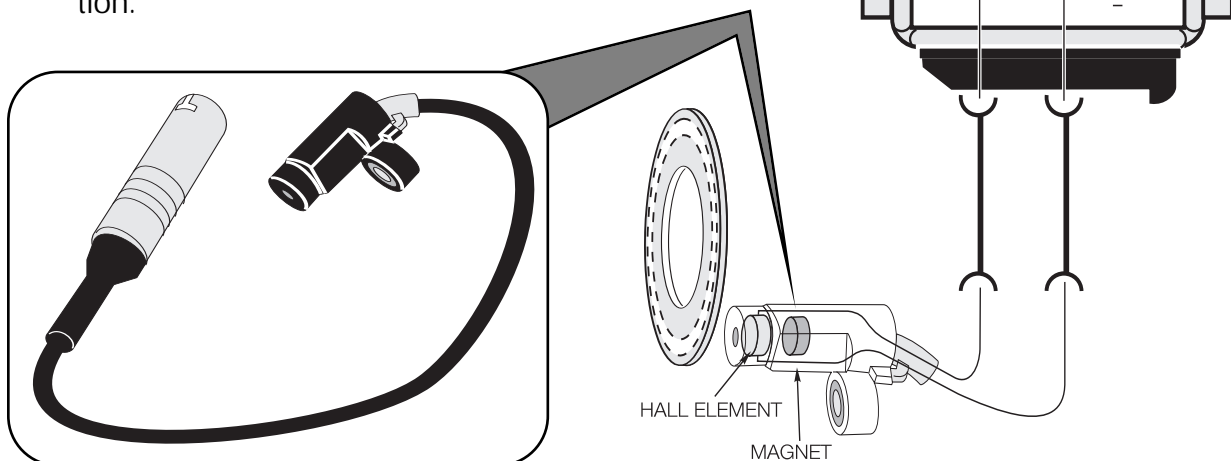
DSC Switch

The system is active whenever the ignition is switched on. When pressed, the switch provides a momentary 12 volt signal to the DSC III control module to switch the system off (DSC indicator in cluster illuminated.) When pressed again, the system switches back on (DSC Indicator in cluster goes off.)



Wheel Speed Sensors

- 2 wire Hall Effect Sensor - "Square wave generator".
- 48 pulse incremental wheel incorporated in wheel bearing cover for contaminant protection. 48 pulses = one complete wheel revolution.
- Stabilized 8 volt power supply to hall element on one wire, ground path for sensor through second wire back to control module. Signal is generated by the pulse wheel affecting voltage flow through hall element creating a low of .75 and a high of 2.5 volts.
- Sensors identical to DSC II and ASC V systems.
- Sensors provide immediate vehicle speed recognition.

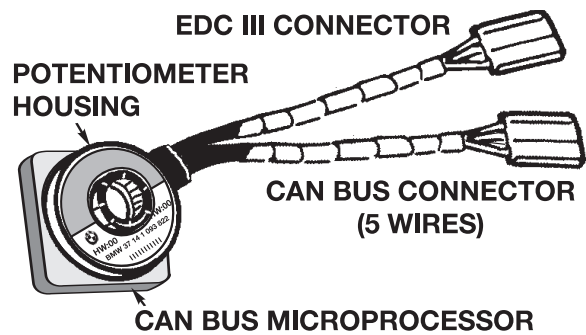


Steering Angle Sensor

The Steering angle sensor is mounted at the bottom of the steering spindle (in front of the flex coupling).

The sensor is equipped with a processor and is directly linked to the CAN bus to communicate with the DSC III module.

The sensor still utilizes two potentiometers to determine the steering angle and the rate of steering. These are the raw signals the CAN Bus microprocessor utilizes to create the steering angle signal for broadcast on the CAN bus.



The sensor requires calibration after repairs to the steering or suspension system (found in DIS Service Functions). Once the calibration is completed the sensor now also sends an identification number over the CAN bus to the DSC III module. The ID provides confirmation in the DSC module that the steering angle sensor is properly calibrated.

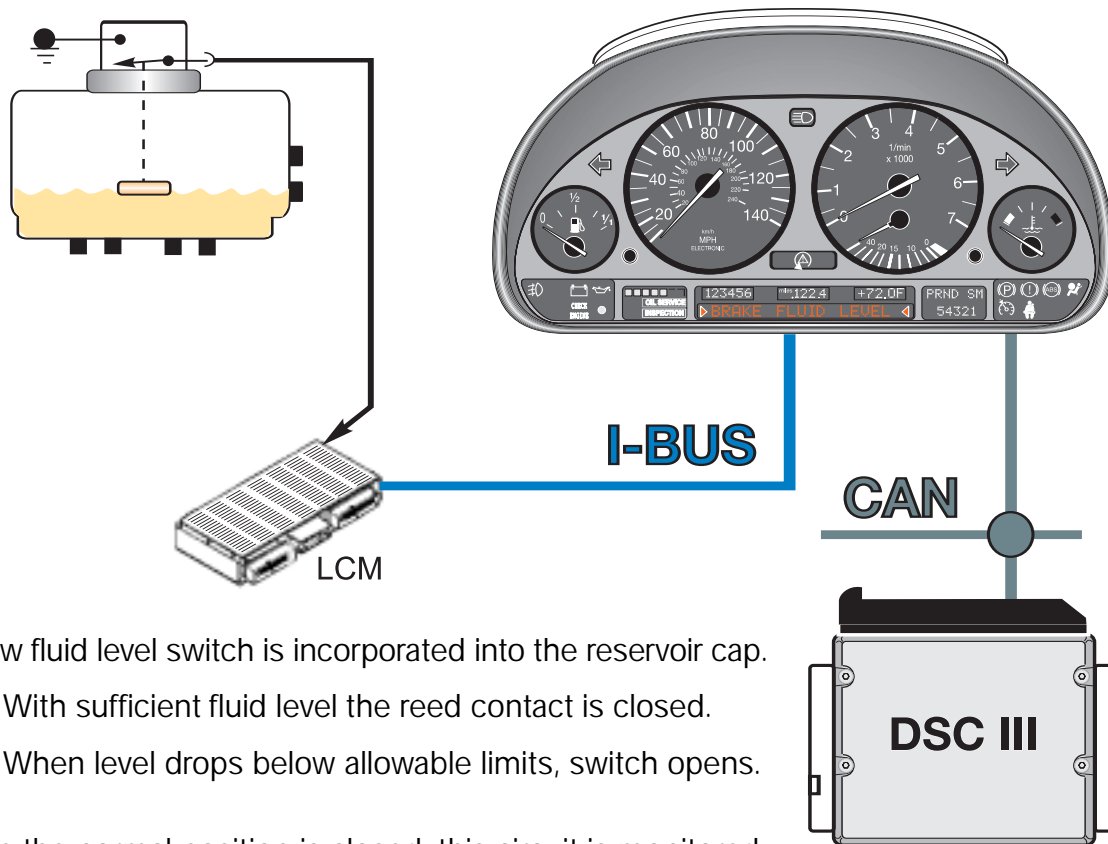
If the ID differs due to component swapping it will not be possible to enter the DSC system for diagnosis. The DIS will request that the steering angle sensor be recalibrated using the service functions. Once complete a new ID number is generated and the DSC III control module and Steering angle sensor are properly mated.

The DSC III logic checks the plausibility of the steering angle sensor against the other DSC III inputs (front wheel speeds, rotation and lateral acceleration sensors). If battery voltage is interrupted, the current steering wheel rotation is recalculated by the DSC module evaluating the front wheel speeds.

Replacement steering angle sensors must be ZCS coded when installed in the vehicle prior to the calibration procedure.

Notes:

Brake Fluid Level Warning Switch



A new fluid level switch is incorporated into the reservoir cap.

- With sufficient fluid level the reed contact is closed.
- When level drops below allowable limits, switch opens.

Since the normal position is closed, this circuit is monitored for shorts to + and ground.

The LCM constantly monitors the input. If the ground signal is momentary, the LCM signals the Instrument cluster of the condition. The instrument cluster then informs the DSC III control module over the CAN bus. If the signal is received just prior to the activation of the charge pump, the charge pump activation is delayed.

If the signal is present for more than 25 seconds, the LCM issues two I BUS message for the Instrument Cluster:

1. Post "Brake Fluid Level" in the Matrix display
2. Notify the DSC III via CAN that the Fluid level has been low for more than 25 seconds.

The DSC III control module immediately switches DSC III functions off and continuously illuminates the DSC indicator in the cluster.

Diagnosis

Diagnosis and troubleshooting of the DSC III system is carried out using the DIS Tester or MoDiC. The DSC control module performs a self check every time the ignition is switched on. The warning lamps for DSC and ABS will remain on during the self check.

Any faults with the system will cause the lamps to remain on when the engine is started. Faults that only effect the DSC operation will cause the DSC warning lamp to remain on, however ABS can still function.

If the battery has been disconnected, the DSC warning lamp will remain on until the vehicle receives road speed signals front the front wheel speed sensors and the steering angle sensor can calculate the direction of travel.

